Emergency Preparedness -- Regional Specialized Meteorological Centers at Washington and Montréal

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Abstract

The history and operations of a cooperative program between the meteorological services of Canada and the United States to model the atmospheric consequences of radioactive releases to the atmosphere is described.

Background

The issue of radioactive fallout has been a driving force for a substantial fraction of research on transport and dispersion conducted by the National Oceanic and Atmospheric Administration (NOAA). In the 1940s and 1950s, when radioactive fallout was a major concern, a special group was organized within NOAA to provide forecasts and assessments of the dispersion and fallout of atmospheric nuclear debris. It soon became apparent that the models developed by this group -- the Air Resources Laboratory (ARL) -- were widely applicable to other situations involving the transport and dispersion of atmospheric contaminants, and ARL research broadened accordingly. However, concerns about nuclear operations and safety remain an important feature of ARL activities.

In Canada, the confusion surrounding the accident at the Three Mile Island nuclear generating station showed the lack of operational dispersion modelling systems in the country. Work started on the development of the Air Quality PACkage (AQPAC), an operational local-scale dispersion model based on the Gaussian plume assumption, and on long-range atmospheric transport and dispersion models. This resulted in the implementation of the first version of the CANadian Emergency Response Model (CANERM). It was soon concluded that the numerical simulation of atmospheric dispersion could be used on an operational basis to support environmental program and emergency response. Based on this argument, the atmospheric component of the federal environmental emergency response program for Canada was moved to the Canadian Meteorological Centre (CMC).

As a result of the poor communications between countries following the Chernobyl accident in the Spring of 1986, the World Meteorological Organization (WMO) was asked by the International Atomic Energy Agency (IAEA) and other international organizations to arrange for early warning messages about nuclear accidents to be transmitted over the Global Tele-communications System (GTS). In addition, some WMO member countries lacking extensive forecasting capability requested that specialized pollutant transport and dispersion forecasts be provided during these emergencies.

In 1989, Global Data Processing Systems (GDPS) Centres at Toulouse and Bracknell and the Canadian Meteorological Centre were set up under interim arrangements between the WMO and the IAEA. Under these arrangements*, GDPS Centre Toulouse* was to provide global coverage (with GDPS Centre Bracknell and the Canadian Meteorological Centre as the backup centers)

until each WMO region had at least two Regional Specialized Meteorological Centres (RSMCs) for the provision of atmospheric transport model outputs for nuclear or radiological emergencies.

The need for rationalization of transport and dispersion forecasts became even more apparent during the oil fire emergency after the Gulf War, when many organizations provided ground personnel with predictions of the smoke plume behavior. These predictions were often misleading; there was no existing and well-recognized system to sort out the predictions from less experienced sources.

In November 1992, a demonstration of NOAA's and CMC's RSMC capabilities was made to the WMO's Commission for Basic Systems (CBS) during their Tenth Session. Following this demonstration, both RSMC designations were decided by WMO and subsequently became effective 1 July 1993. This resulted in two RSMCs per WMO region -- Washington and Montréal for RA IV and Toulouse and Bracknell for RA VI -- and indicated the need to revise the interim arrangements. Under the new global arrangements, Region IV is responsible for parts of Central and South America Region III), while Toulouse and Bracknell cover the remaining Regions I and II (Africa and Asia). These new global arrangements were finalized at the WMO/CBS session in August 1994.

Recently, a fifth RSMC has been set up, in Melbourne, Australia, to provide products for Region V (western Pacific). The Melbourne RSMC has been initiated using some of the Washington (i.e. ARL) procedures and dispersion models. The RSMCs in Washington and Montréal will provide backup to Melbourne. It is expected that more RSMCs will be designated in the near future in order to provide adequate operational support within all the WMO Regions.

Structure

The RSMC Washington is a joint venture between two components of the National Oceanic and Atmospheric Administration (NOAA) -- the National Centers for Environmental Prediction (NCEP) of the National Weather Service and the Air Resources Laboratory of the Office of Oceanic and Atmospheric Research. This collaboration merges the forecast skills and operational capabilities at NCEP with the pollutant dispersion modeling and analysis capabilities of ARL. In essence, NCEP provides the 24 hour per day initial contact point for assistance requests. In the event of an accident, the operational staff connect to dedicated dispersion models operational on the NCEP computer system, which are continuously updated with NCEP forecast model output fields. Customized transport and dispersion models are then run. Model outputs are distributed automatically to predesignated country representatives.

After the initial response by NCEP, the operational responsibility would be transferred to ARL, which at that point might modify the dispersion model products to more accurately reflect the conditions of the accident. The ARL response capability to assist in the RSMC's operation has been developed through various automated systems processes that fully utilize modern telecommunications capabilities (facsimile, E-mail, and the GTS message center, for example).

Recently, a joint project was initiated between ARL and NCEP to develop a more operational coupled meteorological-dispersion model. Modifications are being made to NCEP's Regional Spectral Model (RSM) to permit its application over any region of the globe. RSM model outputs will be linked directly with ARL dispersion models.

RSMC Montréal is located at the CMC which is the national meteorological centre for Canada. The CMC operates around the clock and provides a variety of essential numerical weather prediction (NWP) products and services in Canada. It also manages the supercomputing and telecommunications networks of the Canadian weather service and well as the national climate archives. The atmospheric component of the federal environmental emergency response program for Canada is also managed from this Centre. At CMC, the meteorological and systems development and research personnel work closely with operations staff to ensure that the operational requirements are met and that the operational NWP systems are at the leading-edge of science and technology. Experienced meteorologists, computer specialists and technical staff perform operational duties around the clock to monitor and control the NWP forecast production and dissemination systems which constitute the basis for atmospheric transport and dispersion modelling during an emergency.

Upon notification that atmospheric transport model outputs for an emergency are required, the shift supervisor would notify the scientist on-call and execute the CANERM model using standard defaults. For serious accidents, the Environmental Emergency Response Team would be called upon. The default scenarios will vary depending on the type of accident. In the case of an RSMC response, the default scenarios are identical for all the centres involved.

By agreement with the Canadian Meteorological Center (CMC), RSMCs Washington and Montréal will respond jointly to emergencies in their region of concern, each sending products to countries requesting assistance, as well as consulting with each other regarding model output differences, product interpretation, and uncertainty. Regular monthly tests have been conducted with the CMC since the fall of 1993.

Example

The standard model products to be distributed include forecasts of trajectories, air concentrations, and deposition. The attached illustrations, an example from a monthly test between CMC (Fig. 1) and NOAA (Fig. 2), shows the 24 h average air concentrations for a period 24 to 48 hours after a hypothetical release. This example shows the typical good agreement between the CMC and NOAA calculations, although each is using different dispersion models (Eulerian and Lagrangian, respectively) and different meteorological forecast models.

There is a continuing program intended to identify occasions in which differences in RSMC predictions arise, and to find the causes for these differences. Dispersion model differences are partly due to differences in meteorological model's spatial resolution as well as the effects of the fundamental methods used to compute the pollutant dispersion. Prediction differences will have to be addressed by emergency planners when confronted by multiple model output products. Regional RSMCs (such as Washington and Montréal) will issue statements on differences between their products.

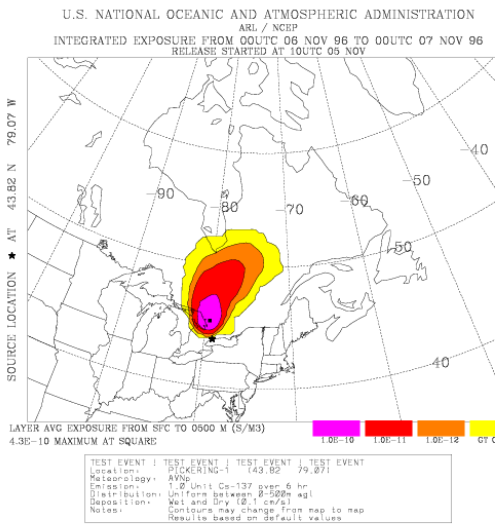

Figure 1 Sample output from RSMC Montréal's dispersion forecast model. Concentration contours are shown at intervals of a factor of 100.

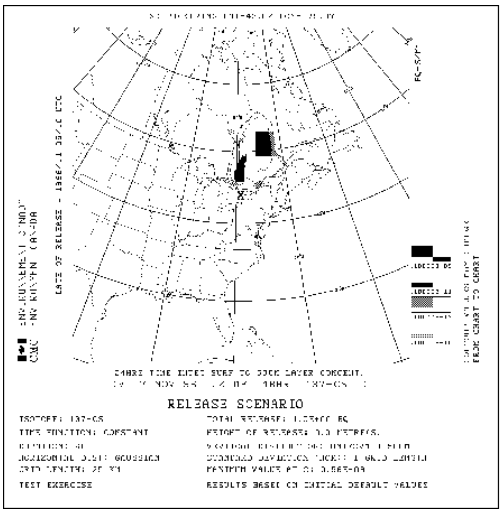

Figure 2 Sample output form RSMC Washington's dispersion forecast model. Concentration contours are shown at intervals of a factor of 10 and where "GT 0.0" indicates any area of concentrations greater than zero.

Training

WMO has recognized the need to train the users of these specialized RSMC products. To assist in the training process, ARL has developed an interactive program for desktop computers that can be used to view model products as well as run some simple variations directly on a personal computer. French and Spanish language versions have been prepared for distribution to regional national meteorological services.

The CMC, in conjunction with Meteo France, has prepared extensive training documentation, covering the fundamentals of pollutant transport theory as well as the operational requirements for countries to request RSMC assistance.